

# PROCEEDINGS

2<sup>nd</sup> International Conference on  
Adaptive and Intelligent Agroindustry (ICAIA)

September 16 - 17, 2013

**IPB International Convention Center  
Bogor - Indonesia**



Organized by:



Department of Agroindustrial  
Technology



ASOSIASI  
AGROINDUSTRI  
INDONESIA  
*Indonesian Agroindustry Association*



Dias Nalalis IPB ke 50  
1963-2013



Sponsored by:

**CIGARIS**

[www.cigaris.com](http://www.cigaris.com)



**trust**



## CONFERENCE COMMITTEE

Coordinator : Yandra Arkeman, Dr. M.Eng  
(Departement of Agroindustrial Technology, IPB)  
Co-Coordinator: Nastiti Siswi Indrasti, Prof. Dr. Ir.  
(Head of Departemen of Agroindustrial Technology, IPB)

### International Experts:

1. Kenneth De Jong, Prof.  
(George Mason University, Fairfax, Virginia, USA)
2. Kim Bryceson, Prof.  
(School of Agriculture and Food Science , University of Queensland, Australia)
3. Haruhiro Fujita, Prof.  
(Department of Information Systems, Niigata University for International and Information Studies Japan)
4. Gajendran Kandamsany, Dr. (United Kingdom)
5. Noel Lindsay, Prof. (University of Adelaide, Australia)

### Committee Members from IPB:

1. Kudang Boro Seminar, Prof.  
(Departement of Mechanical & Bio-system Engineering, IPB)
2. Marimin, Prof.  
(Departement of Agroindustrial Technology, IPB)
3. Endang Gumbira Said, Prof.  
(Departement of Agroindustrial Technology, IPB)
4. Suprihatin, Prof.  
(Secretary of Departement of Agroindustrial Technology, IPB)
5. Ono Suparno, Prof.  
(Departement of Agroindustrial Technology, IPB)
6. Agus Buono, Dr.  
(Head of Department of Computer Science, IPB)

## PROCEEDINGS

2<sup>nd</sup> International Conference on Adaptive and Intelligent Agroindustry (ICAIA)  
September 16 – 17, 2013, IPB International Convention Center  
Bogor – Indonesia

---

### Organized by :

Departement of Agroindustrial Technology, Faculty of Agricultural Engineering and  
Technology Bogor Agricultural University

George Mason University, Fairfax, Virginia, USA

Indonesian Agroindustry Association (AGRIN)

---

Bogor, Desember 2013  
Frekwensi Terbitan : 1 Tahunan  
Nomor ISSN : 2354-9041



## **WELCOMING ADDRESS**

**Prof. Dr. Ir. Nastiti Siswi Indrasti**

Head of Agroindustrial Technology Department  
Faculty of Agricultural Engineering and Technology  
Bogor Agricultural University

**On**

**Second International Conference on Adaptive and Intelligence Agroindustry (2<sup>nd</sup> ICAIA)**

Bogor, September, 16 – 17, 2013

Assalamu'alaikum Warohmatullahi Wabarokatuh  
In the name of Allah, the beneficent and the merciful,

Distinguish Guest, Ladies and Gentlemen

Let me first thank you all for accepting the invitation to participate in this 2<sup>nd</sup> International Conference on Adaptive and Intelligence Agroindustry (ICAIA). In particular I would like to thank Rector of IPB (Institut Pertanian Bogor/Bogor Agricultural University) Prof. Herry Suhardiyanto for supporting this event as part of the series academic event in celebrating the 50<sup>th</sup> Anniversary of Bogor Agricultural University.

In fact, the idea of organizing this conference was the continuation of the International Workshop on Computational Intelligence and Supercomputing Technology for Adaptive Agroindustry held by the Department of Agroindustrial Technology, Bogor Agricultural University last year.

Professor Kenneth A De Jong from George Mason University, US has successfully conducted joint international research with some staff from the Department of Agroindustrial Technology and Department of Computer Science, Bogor Agricultural University. The research aims to develop an integrated and intelligent system (namely SMART-TIN©) for the design of adaptive agroindustrial system in order to achieve a sustainable agroindustry that can mitigate global climate change and at the same time secure food, water, energy and natural medicine supply.

We are certainly proud to have been able to assemble this event in IPB, Bogor. The range of participants and audience at this conference is precisely something I would like to stress. The main goal of the conference is to provide an effective forum for distinguished speakers, academicians, professional and practitioners coming from universities, research institutions, government agencies and industries to share or exchange their ideas, experience and recent progress in Adaptive and Intelligent Agroindustry.

Distinguish Guest, Ladies and Gentlement,

Global climate change is the most challenging problems for us today and in the near future. This global change in our climate can lead to the shortage of the food, water, bioenergy and natural medicine that will affect the quality of human life. Many studies indicate that the threat of food, water, bioenergy and natural medicine crisis due to global climate change still worries our society. This problem can be solved by the development of agroindustry, i.e. an interrelated value chain entities from farming, to agro-processing industry and then to the end-customers. In fact, the design of agroindustry is complex and involves many factors and large data bases and more importantly, needs a good intelligence to process data and information to good decisions. Therefore, the way to design and manage agroindustry should be improved in order to meet the design objectives.

Agroindustries consume quite significant amount of energy on one side, on the other side they generate sizable amount of industrial wastes and its utilization as a captive energy resource is a kind of potential. Based on our study, a plywood industry with the production capacity of 200.000 m<sup>3</sup>/year could generate 32 percentage of solid waste. If this amount of waste used as an energy alternative, it may result on the saving of 131.037.768.597 rupiah per month. Similar to plywood industry, sugarcane industry with the production capacity of 480 ton per hour could generate 154 ton per hour of waste (bagasse) and this amount of waste contribute to the saving of energy consuming by 19.250 Kwh. Recent study we conducted, indicated that cassava starch industry may contribute to a significant amount of waste. It has also potential usage as an energy resource. Based on our study the conversion of its waste into energy will contribute to the saving of energy usage of 4100 liter biogas per ton material.

The three industries mentioned is only examples of how potential the role of agroindustrial waste as an alternative resource in replacing the conventional energy resource as its presence will be significantly

reduced. The new, incremental energy contributions that can be obtained from waste biomass will depend on future government policies, on the rates of fossils fuel depletion, and on extrinsic and intrinsic economic factors, as well as the availability of specific residues in areas where they can be collected and utilized. All of these factors should be in detail examined to evaluate the development of the industrial waste contribution. Hope this conference will also discuss this issue in more detail as it is an important matter for all of us. We should no more think just how to produce high value product but it is also necessarily important how to keep our live in good quality by understanding following old saying...” only when the last tree has been cut, only when the last fish has been angled, and only when the last river has been polluted, then we realized that we could not eat money”.

I do not to take up any more of your time with these opening remarks. Let me simply thank you once again for sharing your thoughts with us. Here’s wishing every success for the conference. May Allah bless all of us.

Thank you for your kind attention,  
Wassalamu’alaikum Warohmatullahi Wabarokatuh

## AGENDA of 2<sup>nd</sup> International Conference on Adaptive and Intelligent Agroindustry (ICAIA)

Time	Activities	Room			
<b>Day 1 (16 September 2013)</b>					
08.00 – 09.00 (60')	Registration				
09.00 – 10.00 (60')	Opening Ceremony <ul style="list-style-type: none"> <li>• Welcoming Address: Prof. NastitiSiswiIndrasti (Head of Dept TIN, Fateta, IPB)</li> <li>• Conference Opening: Prof. HerrySuhardiyanto(Rector of IPB)               <ul style="list-style-type: none"> <li>○ ABET Certification announcement and short ceremony</li> <li>○ Launching International Double Degree Master Program in Innovation and Technopreneurship in Cooperation with University of Adelaide, Australia</li> <li>○ Soft-launching Master in <i>Logistik Agroindustri</i> (Agroindustrial Logistics)</li> </ul> </li> </ul>	Ballroom			
10.00 – 10.45 (45')	Opening Speeches: Prof. IrawadiJamaran (Agroindustry Guru, IPB: 25') Prof. Eriyatno (Industrial and System Engineering, IPB: 20')	Ballroom			
<b>Session 1</b>					
10.45 – 11.15 (30')	Keynote Speech Dr. YandraArkeman (IPB)	Ballroom			
11.15 – 12.00 (45')	Keynote Speech Prof. Kenneth De Jong (George Mason University, USA)	Ballroom			
12.00 – 13.30 (90')	Lunch Break				
<b>Session 2</b>					
13.30 – 15.15 (105')	Moderator: Prof. EndangGumbiraSa'id (IPB) Invited Speakers (1-4) (4 x 20 minutes) Discussion (25 minutes) Tentative Schedule: Prof. Kim Bryceson (Australia), Prof. SyamsulMa'arif (IPB), Prof. KudangBoro Seminar (IPB), Prof. HaruhiroFujita (Japan)	Ballroom			
15.15 – 15.45 (30')	Break				
15.45 – 17.30 (105')	Moderator: Prof. Marimin (IPB) Invited Speakers (5-8) (4 x 20 minutes) Discussion (25 minutes) Tentative Schedule: Dr. Gajendran (UK), Prof. Noel Lindsay (University of Adelaide), Dr. KuncoroHartoWidodo (UGM), Prof. UtomoSarjonoPutro (ITB)	Ballroom			
<b>Day 2 (17 September 2013)</b>					
08.00 – 08.30 (30')	Registration				
08.30 – 10.15 (105')	Moderator: Prof. KudangBoro Seminar (IPB) Invited Speakers (9-12) (4 x 20 minutes) Discussion (25 minutes) Prof. Egum (IPB), Prof. Marimin (IPB), Dr. AgusBuono (IPB), Dr. HeruSukoco (IPB)				
10.15 – 10.30 (15')	Coffee Break				
10.30 – 12.30 (120')	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; vertical-align: top;"> <b>Parallel Session 1</b>            Moderator: Prof. Fujita            (7 paper @ 15 minutes)            Discussion (15 minutes)         </td> <td style="width: 33%; vertical-align: top;"> <b>Parallel Session 2</b>            Moderator: Prof. Ono Suparno            (7 paper @ 15 minutes)            Discussion (15 minutes)         </td> <td style="width: 33%; vertical-align: top;"> <b>Parallel Session</b>            Moderator: Prof. Suprihatin            (7 paper @ 15 minutes)            Discussion (15 minutes)         </td> </tr> </table>	<b>Parallel Session 1</b> Moderator: Prof. Fujita (7 paper @ 15 minutes) Discussion (15 minutes)	<b>Parallel Session 2</b> Moderator: Prof. Ono Suparno (7 paper @ 15 minutes) Discussion (15 minutes)	<b>Parallel Session</b> Moderator: Prof. Suprihatin (7 paper @ 15 minutes) Discussion (15 minutes)	
<b>Parallel Session 1</b> Moderator: Prof. Fujita (7 paper @ 15 minutes) Discussion (15 minutes)	<b>Parallel Session 2</b> Moderator: Prof. Ono Suparno (7 paper @ 15 minutes) Discussion (15 minutes)	<b>Parallel Session</b> Moderator: Prof. Suprihatin (7 paper @ 15 minutes) Discussion (15 minutes)			

12.30 – 13.30 (60')	Lunch Break	
13.30 – 15.00 (90')	Open Discussion (Open Forum) with Prof. Kenneth De Jong Topic: Foundations and Applications of Genetic/Evolutionary Algorithms	Ballroom
15.00 – 15.30 (30')	Conference Closing	Ballroom
15.30 – 17.00 (90')	Indonesian Agroindustry Association (AGRIN) National Congress (PIC: Prof. Suprihatin)	Ballroom
17.00 – 17.45 (45')	Refreshment and Closing of AGRIN National Congress	Ballroom

## CONTENT LIST

Conference Committee

Welcoming Address .....	i
Agenda of 2 <sup>nd</sup> ICAIA 2013.....	iii
Content List .....	v

A.	SMART-TIN© : An Integrated And Intelligent System For The Design Of Adaptive Agroindustry (A Conceptual Framework) (Yandra Arkeman)	1-9.
B.	GHG Emission Reduction By Waste Cooking Oil Recycling In Environmental Partnership Program Of Bogor City (Haruhiro Fujita, Atsushi Yoshimoto, Katsuyuki Nakano, Koji Okuhara, Noriaki Koide, Dadang Supriatna)	10-16.
C.	Challenge of Indonesian Logistics Infrastructure for Perishables Products (Kuncoro Hartoto Widodo, Yandra Rahardian Perdana, Joewono Soemardjito)	17-28.
D.	Design Of Grouping Traditional Market Distribution Using Fuzzy Clustering And Design of Routing of Packaging Cooking Oil From Distribution Center To Traditional Market Using Traveling Salesperson Problem– Genetic Algorithm in Indonesia (Case-Jakarta) (Teja Primawati Utami, Syamsul Maarif, Yandra Arkeman, Liesbetini Hartoto)	29-43.
E.	Determining the degree of product rightness at the conceptual stage:A Case of the Low Cost Green Car (Ade Febransyah, Fransisca Tharia)	44-53.
F.	Co-Composting Process Of Bagasse And Sludge From Sugarcane Industry With Influence Of Difference Initial C/N Value And Aeration (Andes Ismayana, Nastiti Siswi Indrasti, Tori Sane)	54-62.
G.	Analysis Of The Competitiveness Of The Agribusiness Sector Companies Using Porter's Five Forces (M. Hudori)	63-72.
H.	Design And Optimization Of Agro-Scm For Food And Energy Security In Indonesia (Hoetomo Lembito, Kudang Boro Seminar, Nunung Kusnadi, Yandra Arkeman)	73-83.
I.	Construction Of Patchouli Oil's Price In West Java : A Structural Equation Model (Isti Surjandari, Alan Dwi Wibowo, Erlinda Muslim, Nurwan Nugraha)	84-90.
J.	Optimization Vehicle Routing Problem With Cross Entropy Method And Branch & Bound Algorithm (Iwan Aang Soenardi, Budi Marpaung)	91-99.
K.	Design And Optimization Of Agro-Scm For Food And Energy A Remote Monitoring System Of Broilers' Behavior In A Multi-Agent Broiler Closed House System (K.B. Seminar, R. Afnan, M. Solahudin, Supriyanto, A.K. Wijayanto, M.Z. Arifin, A. Fatikunnada)	100-112.
L.	Artificial Neural Network Model Based Capacitance Dielectric For Crackers Self-Life Prediction (Erna Rusliana Muhamaad Saleh, Erliza Noor, Taufik Djatna, Irzaman)	113-121.
M.	Characterizing Temporal Dynamic Of Weather Variability To Support Decision Making On Weed Control (Rizky Mulya Sampurno, Kudang B. Seminar, Yuli Suharnoto, Mohamad Solahudin)	122-130.

N.	Risk Management Model in Dairy Product Transportation With Fuzzy Logic Approach (Winnie Septiani, Yandra Arkeman)	131-141.
O.	Strategy to Increase Institutional Capacity of Farmer Groups to Support the Transportation System Agroindustry Products (Zulfiandri, Yandra Arkeman)	142-156.
P.	Adsorption Of Carotenoid From Palm Oil Methyl Ester By Using Attapulgate And Synthetic Silica Magnesium As Adsorbent (Sapta Raharja, Prayoga Suryadarma, Zuni Fitriyantini)	157-163.
Q.	High Accuracy Agroindustry Environment Monitoring System Based on Photonic Crystal Sensor Network (Mamat Rahmat, Muhamad Azis, Erus Rustami, Wenny Maulina, Kudang Boro Seminar, Arief Sabdo Yuwono, Husin Alatas)	164-174.
R.	Study on Effect of Temperature Increase on the Productivity of Methane from POME Fermentation (Saron, E. Gumbira Said, Ono Suparno, Suprihatin, Udin Hasanudin)	175-180.
S.	The Design and Implementation of Geographic Information Systems to Support Food and Energy Security (Arif Purnomo Muji Basuki, Yandra Arkeman, Musthofa)	181-191.
T.	Study Of White Crystal Sugar Distribution System In Indonesia (Suripto, Yandra Arkeman)	192-199.
U.	Corn cob Bidelignification Process Using White Rot Fungi (Liesbetini Hartoto, Purwoko, Elis Nina Herliyana, Cucu Rina Purwaningrum)	200-212.
V.	Color Stability of Beet Dyes Label During Heating (Endang Warsiki, Asih Setiautami)	213-219.
W	Precipitation Classification Using LVQ on Dry Season Base on Global Climate Indices Case Study in Indramayu District (Indra Kelana Jaya, Agus Buono, Yandra Arkeman)	220-225.
X.	Wood Identification Type By Using Support Vector Mechine-Based Image (A.A. Gede Rai Gunawan, Sri Nurdiati, Yandra Arkeman)	226-232.
Y.	Fuzzy Logic Systems and Applications in Agro-industrial Engineering and Technology (Marimin, Mushthofa)	233-241.
Z.	Adaptive Learning Model of Hypergame by using Genetic Algorithm: an Application of Value Co-creation in Service System (Case Study: Airline Service) (Santi Novani, Utomo Sarjono Putro)	



# Design Of Grouping Traditional Market Distribution Using Fuzzy Clustering And Design of Routing of Packaging Cooking Oil From Distribution Center To Traditional Market Using Traveling Salesperson Problem– Genetic Algorithm in Indonesia (Case- Jakarta)

## **Teja Primawati Utami**

Department of Agroindustrial Technology  
Bogor Agricultural University  
E-mail: [tejaprimawati@yahoo.com](mailto:tejaprimawati@yahoo.com)

## **Syamsul Ma'arif**

Department of Agroindustrial Technology  
Bogor Agricultural University  
E-mail: [syamsul4958@gmail.com](mailto:syamsul4958@gmail.com)

## **Yandra Arkeman**

Department of Agroindustrial Technology  
Bogor Agricultural University  
E-mail: [yandra\\_ipb@yahoo.com](mailto:yandra_ipb@yahoo.com)

## **Liesbetini Hartoto**

Dept. of Agroindustrial Technology,  
Faculty of Agricultural Technology and Engineering IPB  
([liesbetinihartoto@yahoo.com](mailto:liesbetinihartoto@yahoo.com))

## **ABSTRACT**

This paper presents the modelling of intelligent routing of transportation of packaging cooking oil from the center to traditional market in the cluster in Indonesia, especially in Jakarta. Indonesia is the nation who have many island. every island have different population of people. Everyday, many people go to traditional market to buy main consumption products like palm oil etc. price of palm oil is very sensitive to increase when it lack at the market, so sustainable of present the palm oil at the market are very important. Focus of this research is to demonstrate how to optimize of routing distribution from distribution center to markets in the cluster. Optimum route hope can guarantee the availability of product and stock in the market to maintaining the price. The clustering is created by fuzzy clustering and the routing is created by Transportation Salesperson Problem (TSP) with Genetic Algorithm (GA) method. Which GA is a method for solving optimization problem that based on evolutionary theory in biology

**Keywords:** fuzzy clustering, transportation salesperson problem, genetic algorithm, packaging cooking oil

## **1. INTRODUCTION**

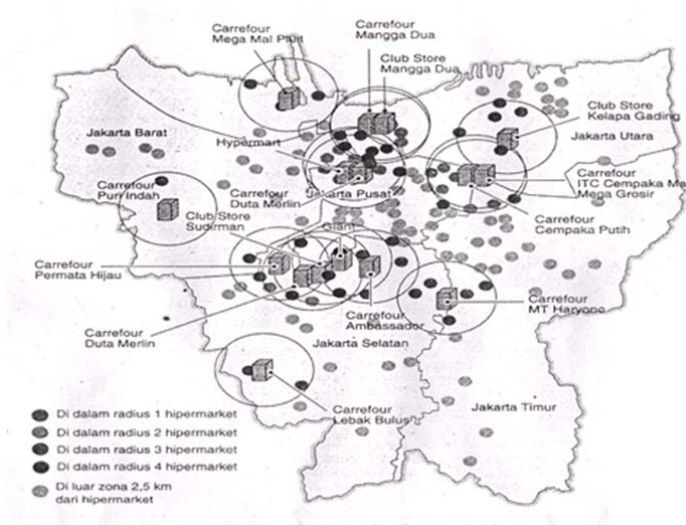
The movement of finished product to customers is market distribution. In market distribution, the end customer represents the final destination (Bowersox, 2002). The ability to deliver goods as customer ordered is service. It will be call logistic which are integrated production and distribution, The logistics components of a corporation consist of: (1) a number of manufacturing plants, (2) zero, one, or more distribution echelons with distribution centres, (3) the customers, (4) the suppliers of components and raw materials, (5) recycling centres for used products and returned packaging containers, and finally (6) the transportation channels that link all of the above components. Goetschalckx et al (2002).

Indonesia is the nation who have many island. every island have different population of people. Every region have many traditional market to serve daily people consumption. These traditional market need distribution centre to ensure availability of consumption product in these traditional market. How to optimum determine distribution centre of each region can defined by clustering. Hamzah (2001) show that clustering process by fuzzy (fuzzy clustering) give the result better that defined it by firm directly approach. In this paper we focus on Jakarta region.

Jakarta is capital city of Indonesia, which have 5 region. There are North Jakarta, South Jakarta, West Jakarta, East Jakarta and Center Jakarta (Figure 1). Traditional market in Jakarta is coordinated by PD Pasar Jaya. PD Pasar Jaya have 153 traditional market (figure 2). Every traditional market uncontrolable for availability of goods and disparity of goods prices. So this paper will purpose to make distribution center to solve this problem.



**Figure 1** :Region of Jakarta Map



**Figure 2** : Traditional markets at Jakarta

Distribution centre will be create by fuzzy clustering. Partition clustering essentially deals with the task of partitioning a set of entities into a number of homogeneous clusters, with respect to a suitable similarity measure. Due to the fuzzy nature of many practical problems, a number of fuzzy clustering methods have been developed following the general fuzzy set

theory strategies outlined by Zadeh (1965). The main difference between the traditional hard clustering and fuzzy clustering can be stated as follows. While in hard clustering an entity belongs only to one cluster, in fuzzy clustering entities are allowed to belong to many clusters with different degrees of membership.

Clustering has been around for many decades and located itself in a unique position as a fundamental conceptual and algorithmic landmark of data analysis. Almost since the very inception of fuzzy sets, the role and potential of these information granules in revealing and describing structure in data was fully acknowledged and appreciated (Mika Sato, 2006).

In the recent years clustering has undergone a substantial metamorphosis. From being an exclusively *data* driven pursuit, it has transformed itself into a vehicle whose data centrality has been substantially augmented by the incorporation of domain knowledge thus giving rise to the next generation of *knowledge-oriented* and *collaborative* clustering. This fuzzy clustering is used.

After distribution centre are defined and need Travelling Salesperson Problem (TSP) to distribute the product to the markets. In the TSP, the goal is to find the shortest distance between  $N$  traveling points. The number of possible route for an  $N$  city tour requires  $N!$  additions. An exhaustive search through all possible paths is acceptable only when  $N$  is small. As  $N$  increases, the number of possible path grows geometrically. A 20-city tour involves  $2.43 \times 10^{18}$  additions. Even with 1 billion additions performed in 1 second, this would take over 1852 years. Adding one more city would cause the number of additions to increase by a factor of 21. Obviously, exhaustive search becomes impractical.

So, to make it more quickly and simply, genetic algorithm is necessary to used for save the time. Genetic Algorithm (GA) is a method for solving optimization problem that based on evolutionary theory in biology. This algorithm work with a population of candidate solutions named as chromosome that initially generated randomly from the area of the solution space of objective function. By using a mechanism of genetic operator i.e. crossover and mutation the population is evolves controlled by fitness function that directed to convergence condition. Widyastuti and Hamzah (2007).

This paper presents the application of GA approach in this cluster markets of routing transportation problem called TSP. Although GA probably will not lead to the best solution, it can find a near optimal solution in a much less time (within several minutes).

## 2. LITERATURE REVIEW

### 2.1. Fuzzy C-Means (FCM)

The fuzzy c-means (FCM) algorithm (Bezdek, 1981) is one of the most widely used methods in fuzzy clustering. Data clustering is the process of dividing data elements into classes or clusters so that items in the same class are as similar as possible, and items in different classes are as dissimilar as possible. Depending on the nature of the data and the purpose for which clustering is being used, different measures of similarity may be used to place items into classes, where the similarity measure controls how the clusters are formed. Some examples of measures that can be used as in clustering include distance, connectivity, and intensity.

There are known two clustering hard and soft. In hard clustering, data is divided into distinct clusters, where each data element belongs to exactly one cluster. In fuzzy clustering (also referred to as soft clustering), data elements can belong to more than one cluster, and associated with each element is a set of membership levels. These indicate the strength of the association between that data element and a particular cluster. Fuzzy clustering is a process of assigning these membership levels, and then using them to assign data elements to one or more clusters.

The FCM algorithm attempts to partition a finite collection of  $n$  elements  $X = \{x_1, \dots, x_n\}$  into a collection of  $c$  fuzzy clusters with respect to some given criterion. Given a finite set of data, the algorithm returns a list of  $c$  cluster centres  $C = \{c_1, \dots, c_c\}$  and a partition matrix  $U = u_{i,j} \in [0, 1], i = 1, \dots, n, j = 1, \dots, c$ , where each

element  $u_{ij}$  tells the degree to which element  $x_i$  belongs to cluster  $c_j$ . Like the  $k$ -means algorithm, the FCM aims to minimize an objective function. The standard function is:

$$u_k(x) = \frac{1}{\sum_j \left( \frac{d(\text{center}_k, x)}{d(\text{center}_j, x)} \right)^{2/(m-1)}}$$

Which differs from the  $k$ -means objective function by the addition of the membership values  $u_{ij}$  and the fuzzifier  $m$ . The fuzzifier  $m$  determines the level of cluster fuzziness. A large  $m$  results in smaller memberships  $u_{ij}$  and hence, fuzzier clusters. In the limit  $m = 1$ , the memberships  $u_{ij}$  converge to 0 or 1, which implies a crisp partitioning. In the absence of experimentation or domain knowledge,  $m$  is commonly set to 2. The basic FCM Algorithm, given  $n$  data points ( $x_1, \dots, x_n$ ) to be clustered, a number of  $c$  clusters with ( $c_1, \dots, c_c$ ) the center of the clusters, and  $m$  the level of cluster fuzziness.

In fuzzy clustering, each point has a degree of belonging to clusters, as in fuzzy logic, rather than belonging completely to just one cluster. Thus, points on the edge of a cluster, may be *in the cluster* to a lesser degree than points in the center of cluster. An overview and comparison of different fuzzy clustering algorithms is available.

Any point  $x$  has a set of coefficients giving the degree of being in the  $k$ th cluster  $w_k(x)$ . With fuzzy  $c$ -means, the centroid of a cluster is the mean of all points, weighted by their degree of belonging to the cluster:

$$c_k = \frac{\sum_x w_k(x)x}{\sum_x w_k(x)}$$

The degree of belonging,  $w_k(x)$ , is related inversely to the distance from  $x$  to the cluster center as calculated on the previous pass. It also depends on a parameter  $m$  that controls how much weight is given to the closest center. The fuzzy  $c$ -means algorithm is very similar to the  $k$ -means algorithm.

Choose a number of clusters. Assign randomly to each point coefficients for being in the clusters. Repeat until the algorithm has converged (that is, the coefficients' change between two iterations is no more than  $\epsilon$ , the given sensitivity threshold).

Compute the centroid for each cluster, using the formula above. For each point, compute its coefficients of being in the clusters, using the formula above. The algorithm minimizes intra-cluster variance as well, but has the same problems as  $k$ -means; the minimum is a local minimum, and the results depend on the initial choice of weights.

The expectation-maximization algorithm is a more statistically formalized method which includes some of these ideas: partial membership in classes. Fuzzy  $c$ -means has been a very important tool for image processing in clustering objects in an image. In the 70's, mathematicians introduced the spatial term into the FCM algorithm to improve the accuracy of clustering under noise.

## 2.2. Cluster Analysis

Cluster analysis or clustering is the task of assigning a set of objects into groups (called clusters) so that the objects in the same cluster are more similar (in some sense or another) to each other than to those in other clusters.

Clustering is a main task of explorative data mining, and a common technique for statistical data analysis used in many fields, including machine learning, pattern recognition, image analysis, information retrieval, and bioinformatics.

Cluster analysis itself is not one specific algorithm, but the general task to be solved. It can be achieved by various algorithms that differ significantly in their notion of what constitutes a cluster and how to efficiently find them. Popular notions of clusters include groups with low distances among the cluster members, dense areas of the data space, intervals or particular statistical distributions. Clustering can therefore be formulated as a multi-objective optimization problem. The appropriate clustering algorithm and parameter settings (including values such as the distance function to use, a density threshold or the number of

expected clusters) depend on the individual data set and intended use of the results. Cluster analysis as such is not an automatic task, but an iterative process of knowledge discovery or interactive multi-objective optimization that involves trial and failure. It will often be necessary to modify preprocessing and parameters until the result achieves the desired properties.

Besides the term *clustering*, there are a number of terms with similar meanings, including *automatic classification*, *numerical taxonomy*, *botryology* (from Greek βότρυς "grape") and *typological analysis*. The subtle differences are often in the usage of the results: while in data mining, the resulting groups are the matter of interest, in automatic classification primarily their discriminative power is of interest. This often leads to misunderstandings between researchers coming from the fields of data mining and machine learning, since they use the same terms and often the same algorithms, but have different goals.

### 2.3. Center of cluster

In centroid-based clustering, clusters are represented by a central vector, which may not necessarily be a member of the data set. When the number of clusters is fixed to  $k$ ,  $k$ -means clustering gives a formal definition as an optimization problem: find the  $k$  cluster centers and assign the objects to the nearest cluster center, such that the squared distances from the cluster are minimized.

The optimization problem itself is known to be NP-hard, and thus the common approach is to search only for approximate solutions. A particularly well known approximative method is Lloyd's algorithm, often actually referred to as "*k-means algorithm*". It does however only find a local optimum, and is commonly run multiple times with different random initializations. Variations of  $k$ -means often include such optimizations as choosing the best of multiple runs, but also restricting the centroids to members of the data set ( $k$ -medoids), choosing medians ( $k$ -medians clustering), choosing the initial centers less randomly ( $K$ -means++) or allowing a fuzzy cluster assignment (Fuzzy  $c$ -means).

Most  $k$ -means-type algorithms require the number of clusters -  $k$  - to be specified in advance, which is considered to be one of the biggest drawbacks of these algorithms. Furthermore, the algorithms prefer clusters of approximately similar size, as they will always assign an object to the nearest centroid. This often leads to incorrectly cut borders in between of clusters (which is not surprising, as the algorithm optimized cluster centers, not cluster borders).

$K$ -means has a number of interesting theoretical properties. On one hand, it partitions the data space into a structure known as Voronoi diagram. On the other hand, it is conceptually close to nearest neighbor classification and as such popular in machine learning. Third, it can be seen as a variation of model based classification, and Lloyd's algorithm as a variation of the Expectation-maximization algorithm for this model discussed below.

### 2.4. Traveling Salesperson Problem

The idea of the travelling salesman problem (TSP) is to find a tour of a given number of cities, visiting each city exactly once and returning to the starting city where the length of this tour is minimized. The first instance of the travelling salesman problem was from Euler in 1759 whose problem was to move a knight to every position on a chess board exactly once (Michalewicz, 1994).

Travelling Salesperson Problem (TSP) is one of the issues combinatorial optimization, if there are a number of cities (or place) and the cost of travel from one city to other cities. Description of the problem is how to find the cheaper route of visit all the cities, each the city is only visited once, and must back to the original departure city. The combination of all the existing route is the factorial of the number of cities. Travel cost can be a distance, time, fuel, convenience, and so forth.

### 2.5. Genetic Algorithm

Genetic algorithms are search techniques and optimization which is inspired by the principles of genetics and natural selection (Darwin's theory of evolution). This algorithm is

used to obtain the exact solution for the optimization problem of a single variable or multi variable.

GA is a general purpose guided random search that based on the natural selection principles of biological evolution to improve the potential solutions. GA includes random elements which help to prevent the search begin trapped in local minimum. These properties overcome some of the short comings of conventional optimization approaches in ill-structured problems (Can and Rad, 2002).

Being inherently parallel, GA are performed over a population of solution candidates. The manipulation process uses genetic operators to produce a new population of individuals (offspring) by manipulation the solution candidates. The algorithms start working by evaluating thousands of scenarios automatically until they find an optimal answer. The genetic algorithms bias the selection of chromosomes so that those with the better fitness functions tend to reproduce more often than those with worse evaluations.

Given an optimisation problem, GA first encode the parameters into solution candidates. In the initial phase, the population consists of randomly enervated heterogeneous solution candidates. After all chromosomes go through evaluation process, an initial population will improve as parents are replaced by better and better children. The best individual in the final population can be a highly evolved solution to the problem.

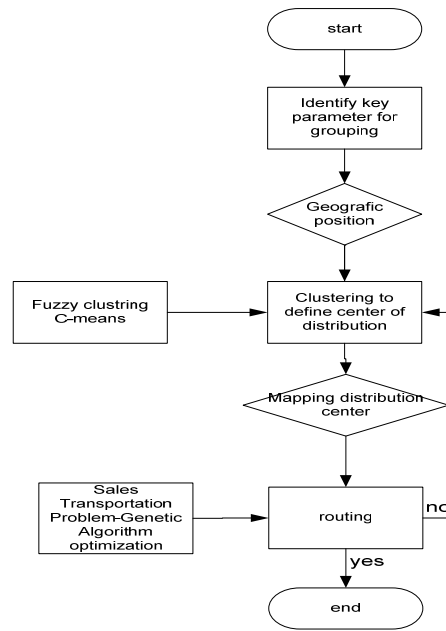
Briant and Arthur (2000), Generally The genetic algorithm process consists of the following steps:

- Encoding
- Evaluation
- Crossover
- Mutation
- Decoding

### **3. METODOLOGI**

Fuzzy clustering is one method which can capture the uncertainty situation of real data and it is well known that fuzzy clustering can obtain a robust result as compared with conventional hard clustering (Sato, 2006). Following the emphasis on the general problem of data analysis, which is a solution able to analyze a huge amount of complex data, the merit of fuzzy clustering is then presented.

After cluster was constructed, next step is to design routing from centre of cluster to the members. The members and the cluster are traditional market in Jakarta, Indonesia. Routing is designed by Transportation Salesperson Problem and Genetic Algorithm is used to make optimization. The methodology framework is bellow on Figure 3.



**Figure 3 :** The Methodology Framework

#### 4. DISCUSSION

There is a great interest in clustering techniques due to the vast amount of data generated in every field including business, health sciences, engineering and aerospace. It is essential to extract useful information from the data. Clustering techniques are widely used in pattern recognition and related applications. This research monograph presents the clusters for traditional market in Jakarta, which these have each distribution centre.

##### 4.1. Identify Parameter for Grouping

Clustering of traditional market in Jakarta are constructed by 4 parameter combining. These are latitude position, longitude position, density of traders at the markets and accessibility of 153 transitional markets.

##### 4.2. Clustering to define centre of distribution

Centre of distribution of traditional market in Jakarta is defined by fuzzy clustering. we use MATHLAB to create the clustering. Fuzzy clustering with c-means is used for data analysis. The algorithm of fuzzy c-means (FCM) are below :

- Input data to be in the cluster is a matrix of  $n \times m$  ( $n$  = number of data sample,  $m$  – attribute for each data).  $X_{ij}$  = sample data to  $i$  ( $i = 1, 2, \dots, n$ ), attribute to- $j$  ( $j=1, 2, \dots, m$ ).
 

Umber of cluster ( $c$ )	= 15
Square ( $w$ )	= 2
Maximum iteration ( $maxIter$ )	= 100
Error ( $\epsilon$ )	= $10^{-5}$
First objective function ( $P_0$ )	= 0
First iteration ( $t$ )	= 1
- Random number ( $\mu_{ik}$ ) generated,

$i = 1, 2, \dots, n; k = 1, 2, \dots, c;$  with sequence below.

$$Q_j = \sum_{k=1}^c \mu_{ik}$$

$j = 1, 2, \dots, m$   
which are,

$$\mu_{ik} = \frac{\mu_{ik}}{Q_j}$$

3. Center of cluster to-k ;  $V_{kj}$  with  $k = 1, 2, \dots, c;$  and  $j = 1, 2, \dots, m$

$$V_{kj} = \frac{\sum_{i=1}^n ((\mu_{ik})^w * X_{ij})}{\sum_{i=1}^n (\mu_{ik})^w}$$

4. Objective fungsjon at iteration to-t,  $P_t$  :

$$P_t = \sum_{i=1}^n \sum_{k=1}^c \left( \left[ \sum_{j=1}^m (X_{ij} - V_{kj})^2 \right] (\mu_{ik})^w \right)$$

5. Partition matrix change

$$\mu_{ik} = \frac{\left[ \sum_{j=1}^m (X_{ij} - V_{kj})^2 \right]^{\frac{-1}{w-1}}}{\sum_{k=1}^c \left[ \sum_{j=1}^m (X_{ij} - V_{kj})^2 \right]^{\frac{-1}{w-1}}}$$

$i = 1, 2, \dots, n ;$  and  $k = 1, 2, \dots, c$

6. Finish iteration

If :  $(|P_t - P_{t-1}| < \varepsilon)$  or  $(t > MaxIter)$  so iteration is stoping.;

If not  $t = t+1,$  looping go to 3.

Clustering of numerical data forms the basis of many classification and system modelling algorithms. The purpose of clustering is to identify natural groupings of data from a large data set to produce a concise representation of a system's behaviour.

Fuzzy Logic Toolbox tools allow to find clusters in input-output training data. It can use the cluster information to generate a Sugeno-type fuzzy inference system that best models the data behaviour using a minimum number of rules. The rules partition themselves according to the fuzzy qualities associated with each of the data clusters. the command-line function is using, `genfis2` to automatically accomplish this type of FIS generation.

Quasi-random two-dimensional data is used to illustrate how FCM clustering works. To load the data set and plot it, type the following commands:

```
load sheet1.dat
plot(sheet1(:,1), sheet1(:,2), 'o')
```

Next, invoke the command-line function `fcm` to find two clusters in this data set until the objective function is no longer decreasing much at all.

```
[center,U,objFcn] = fcm(sheet1sheet1,15);
```

Here, the variable `centre` contains the coordinates of the fifteen cluster centres, `U` contains the membership grades for each of the data points, and `obj Fcn` contains a history of the objective function across the iterations.

**Table 1.**history of the objective function across the iterations



ITERATION	FCN
Iteration count = 1	obj. fcn = 0.041209
Iteration count = 2	obj. fcn = 0.030768
Iteration count = 3	obj. fcn = 0.030263
Iteration count = 4	obj. fcn = 0.029399
Iteration count = 5	obj. fcn = 0.027972
Iteration count = 6	obj. fcn = 0.026048
Iteration count = 7	obj. fcn = 0.024263
Iteration count = 8	obj. fcn = 0.022998
Iteration count = 9	obj. fcn = 0.021964
Iteration count = 10	obj. fcn = 0.021105
Iteration count = 11	obj. fcn = 0.020507
Iteration count = 12	obj. fcn = 0.020139
Iteration count = 13	obj. fcn = 0.019853
Iteration count = 14	obj. fcn = 0.019580
Iteration count = 15	obj. fcn = 0.019307
Iteration count = 16	obj. fcn = 0.019042
Iteration count = 17	obj. fcn = 0.018754
Iteration count = 18	obj. fcn = 0.018506
Iteration count = 19	obj. fcn = 0.018407
Iteration count = 20	obj. fcn = 0.018366
Iteration count = 21	obj. fcn = 0.018337
Iteration count = 22	obj. fcn = 0.018313
Iteration count = 23	obj. fcn = 0.018292
Iteration count = 24	obj. fcn = 0.018275
Iteration count = 25	obj. fcn = 0.018262
Iteration count = 26	obj. fcn = 0.018251
Iteration count = 27	obj. fcn = 0.018242

The fcm function is an iteration loop built on top of the following routines:

- `initfcm` — initializes the problem
- `distfcm` — performs Euclidean distance calculation
- `stepfcm` — performs one iteration of clustering

To view the progress of the clustering, plot the objective function by typing the following commands:

```
figure
plot(objFcn)
title('Objective Function Values')
xlabel('Iteration Count')
ylabel('Objective Function Value')
```

Figure of convergency is presented at figure 4.

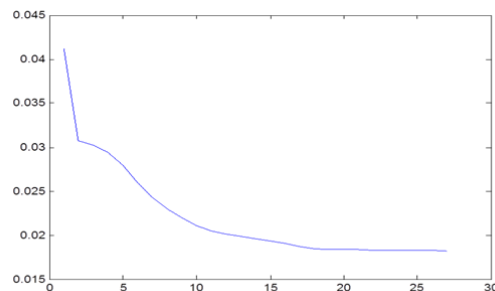


Figure 4 : Convergency Iteration

Finally, plot the fifteen cluster centers found by the fcm function using the following code:

```
maxU = max(U);
index1 = find(U(1, :) == maxU);
index2 = find(U(2, :) == maxU);
figure
```

```

line(fcndata(index1, 1), fcndata(index1, 2), 'linestyle',...
'none','marker', 'o','color','g');
line(fcndata(index2,1),fcndata(index2,2),'linestyle',...
'none','marker', 'x','color','r');
hold on
plot(center(1,1),center(1,2),'ko','markersize',15,'LineWidth',2)
plot(center(2,1),center(2,2),'kx','markersize',15,'LineWidth',2)

```

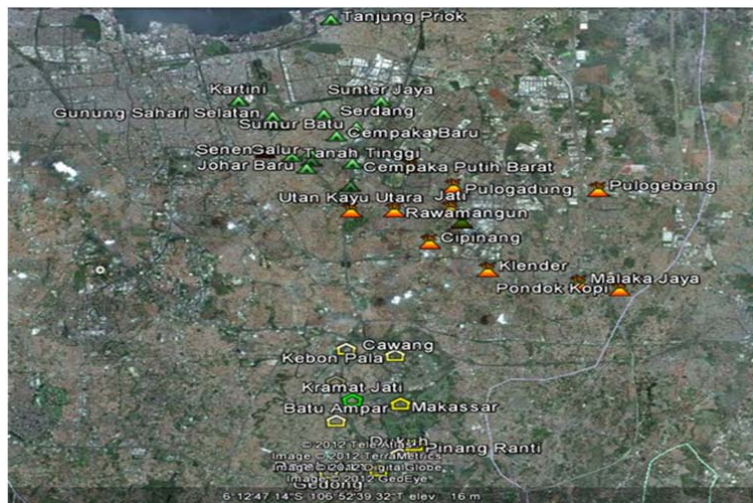
coordinate geographic centre of each cluster is presented below.

**Table 2 :** coordinate geographic centre of each cluster

NO	LATITUDE	LONGITUDE
1	6.166.857	1.065.258
2	6.117.264	1.065.397
3	6.097.971	1.065.185
4	6.113.407	1.064.485
5	6.132.045	1.065.233
6	608.422	1.064.826
7	6.198.298	1.065.389
8	6.177.212	1.065.032
9	6.112.826	106.504
10	614.756	1.064.774
11	6.090.052	1.064.985
12	6.111.806	1.064.832
13	6.075.793	1.065.701
14	6.151.379	1.065.046
15	6.085.015	1.064.342

### 4.3 Mapping distribution centre by fuzzy clustering

These are 15 cluster traditional market in Jakarta was defined. The centres of cluster are present with different colour. One of them will be present bellow.



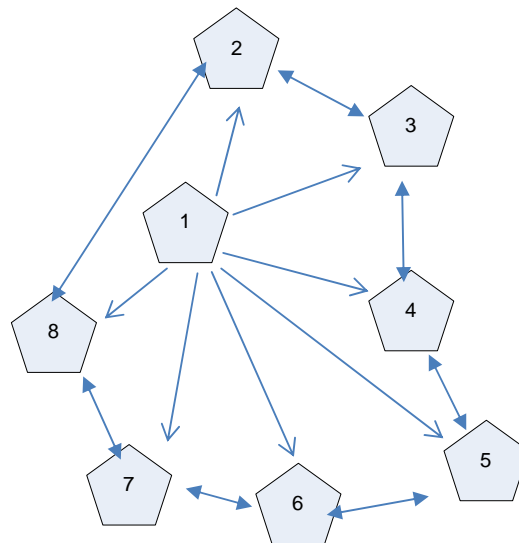
**Figure 5 :** Cluster 1, 2, and 3

### 4.4 Routing with Transportation Salesperson Problem-Genetic Algorithms.

The TSP is a standard problem in optimization. The objective in this paper is to minimize the travelling distance of  $N$  cities in a 10 km square radius from (0,0). Figure 3 for cluster 1 which colour is yellow shows a 8-city tour starting from green dot (kramat jati) colour which is the centre to 7-others cities in the 10 km square radius, where the yellow dots are indicates the city needed to be traveled.

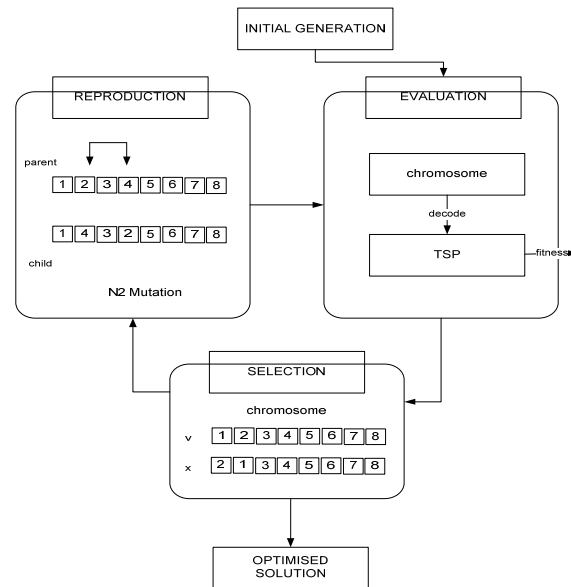


**Figure 6 :** Cluster 3



**Figure 7 :**Cluster one as a sample for routing TSP

Figure 7 describes the flow of the optimization of TSP by GA. GA first encodes the travelling cities into chromosome. The population size is 1. After the chromosome goes through evaluation process, a fitness value is assigned to the chromosome. The child is then compared with the parent. If it is fitter than the parent, it will replace the parent, or it will not be used. Then the parent will reproduce a child through neighbourhood mutation (which will be discussed in part v in this section). The process repeats until it reaches the maximum number of generations. The chromosome in the final population is a highly evolved solution to the problem.



**Figure 8** :Mechanisms of the proposed algorithms

#### 4.4.1 Coding

In GA, the parameters to be optimized are encoded into chromosomes (Figure 8) and each chromosome is a solution candidate. The encoding scheme depends on the nature of parameters to be optimized. In this problem, each city going to be visited is represented by an integer. The chromosome  $S$ , is a sequence of integers, can be formed by encoding the list of cities in the order they are visited. The length of chromosome equals to  $N$ .

#### 4.4.2 Initialization

In this problem, we set the population size equals to 1 and the initial population is randomly generated.

#### 4.4.3 Evaluation

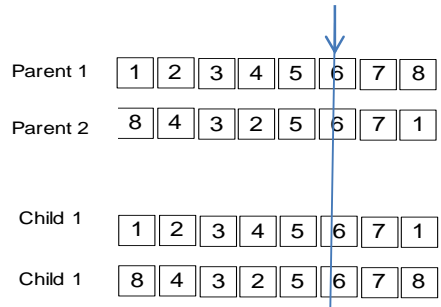
In the evaluation module, each chromosome is coded with the integer of the cities to be travelled and the travelling time is calculated. The fitness value, calculated according to the fitness function, which is defined by the designer, is assigned to the chromosome.

#### 4.4.4 Reproduction and Generation Selection

The reproduction module selects the alleles to be mutated. Then a new child chromosome is produced. The new chromosome is compared with parent chromosome. Elitism is used in the generation selection. If the new chromosome fitter than the parent, then it replaces the parent, else it will not be used. This avoids the loss of potential candidates by copying the best member into the succeeding generation.

#### 4.4.5 Neighbourhood Mutations

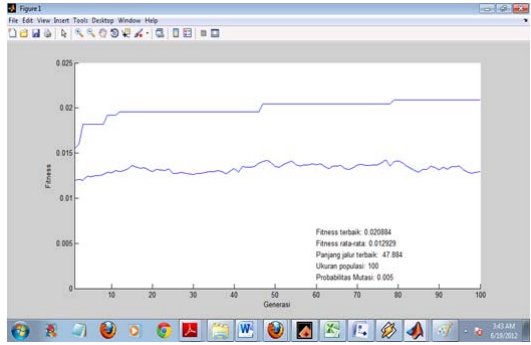
Conventional crossover and mutation are the most commonly used operations in GA to obtain offspring. However, simple crossover and mutation may lead to violation of the constraint of TSP, as the city to be travelled may be missed or duplicated. As shown in Figure 5, the crossover operation will not work. Let's say, we have a 2nd crossover point. Every number in parent 1 before the crossover point is copied into the same position in child 1. Then, every number after the crossover point in parent 2 is put into child 1. The opposite is done for child 2.



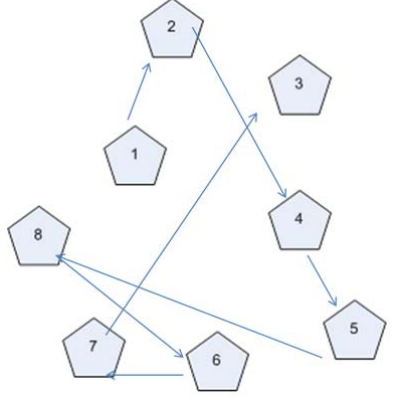
**Figure 9 :** Crossover of chromosome

After the crossover operation, in Child 1, the city 1 is visited twice and city 8 is missed. The reproduction should preserve all the cities required in the chromosomes from the parents to the children. A different approach has therefore been adopted to the reproduction of chromosomes. Ho and Yeung (2000), A neighbourhood is defined for the best chromosome in a generation and the chromosome only evolves to one of its neighbours.

The choice of chromosomes for the initial generation plays a vital role in the convergence toward the optimal solution. In order to smooth out this effect, 20 tests have been carried out for each traffic condition with each neighbourhood definition. In each test, the chromosomes of the initial generation are selected randomly from the set of possible sequences. The average of the minimum crossover the 20 tests is then calculated. All the simulation runs are performed on MATHLAB. Figure 7 summarizes the average travelling distance (of 20 tests) of 8 cities over 100 generations for different neighbourhood mutations.



**Figure 10 :** The average travelling distance (of 20 tests) of 8 cities over 100 generations.



**Figure 11 :** Sample optimum routing of 8 cities from distribution centre (1) to seven other cities

The following pseudo-code that is created for solve the above problems with the TSP using genetic algorithms

```
function Fitness (Kromosom[i])→integer
{calculate the fitness value of each chromosome}
Declaration
    Jum : integer
    j : integer
    Chromosome[][] : array of integer of integer
Distance function (input A, B : integer) → integer
{generate the distance between two cities A and B }
Algorithm
    Jum ← Jarak(A, Kromosom[i][1])
    for j ← 2 to 4 do
        Jum → Jum +
            Distance (chromosome[i][j-1], chromosome [i][j])
    endfor
    Jum ← sum + Jarak(Kromosom[i][4], A)
    → Jum
Crossover procedure (input populasi: integer, pc:real)
{parent selection on the cross over }
```

```
Declaration
    k : integer
    R[] : array of integer
    function random (input a-b :
integer) → nteger
{generates random numbers from a number to b }
```

```
Algorithm
    k= 0
    While k <= populasi do
        R[k] ← random(0-1)
        if R[k] < pc then
            pilih Kromosom[k][ ] sebagai induk
        endif
        k←k+1
    endwhile
```

```
function of Number mutations (input JumGen,
JumlahKromosom: integer, pm: real) →integer
{count the number of the mutations }
```

```
Declaration
    TotalGen : integer
    JumMutasi : integer
```

```
Algorithm
    TotalGen ← JumGen * JumlahKromosom
    pm ← 0.2
    JumMutasi ← 0.2 * TotalGen
    → JumMutasi
```

## 5. CONCLUSION

Traditional market existing is very important to help Jakarta's people life. Everyday they go to traditional market to buy many things for basic need consumption. Availability of goods and stability of price are important to consider. How to make it, this paper give a solution by present the distribution centres to facilitate all of traditional market. Jakarta have 153 traditional markets. It should be distribute to 15 clusters. Each cluster has one centre, it could

be distribution centre. MATLAB is used to calculate and solve the problem by fuzzy clustering. The iteration to convergence are 27 iteration. Every distribution centre is nearly optimum to distribute the goods to all traditional markets in the cluster.

Genetic algorithms appear to find good solutions for the travelling salesman problem, however it depends very much on the way the problem is encoded and which crossover and mutation methods are used. It seems that the methods that use heuristic information or encode the edges of the tour (such as the matrix representation and crossover) perform the best and give good indications for future work in this area.

Overall, it seems that genetic algorithms have proved suitable for solving the travelling salesperson problem. It seems that the biggest problem with the genetic algorithms devised for the travelling salesperson problem is that it is difficult to maintain structure from the parent chromosomes and still end up with a legal tour in the child chromosomes. Perhaps a better crossover or mutation routine that retains structure from the parent chromosomes would give a better solution than we have already found for some travelling salesman problems

## 6. ACKNOWLEDGEMENTS

This research is integral part of SMART TIN Project funded by DIKTI ( Director General of Higher Education, Indonesia )

## REFERENCES

- [1] Andraski, Joseph C. (1998), "Leadership and The Realization of Supply Chain Collaboration," Journal of Business Logistics, Vol. 19, No. 2, pp. 9-11.
- [2] Bowersox, Closs, Cooper. 2002. Supply Chain Logistic Management. Mc Graw Hill. Michigan State University. New York.
- [3] Bryant, K, Benjamin A. 2000. Advisor Genetic Algorithms and the Traveling Salesman Problem. Departement of Mathematic. Harvey Mudd College.
- [4] Chan, P.T. and Rad, A.B. and Ho, T.K. .2002. *Optimisation of a class of transportation problems using genetic algorithms*. In: Traffic And Transportation Studies 2002 : Proceedings of the Third International Conference on Traffic and Transportation Studies, 23-25 July 2002, Guilin, China.
- [5] D'Amours, S., Monreuil, B., Soumis, F., 1996. Price-based planning and scheduling of multiproduct orders in symbiotic manufacturing networks. European Journal of Operational Research 96, 148-66.
- [6] Goetschalckx, M, Vidal, C.J and Dogan, K. 2002. Modeling and design of global logistics systems: A review of integrated strategic and tactical models and design algorithms. European Journal of Operational Research 143 (2002) 1-18
- [7] Gen, M. 1999. Solving Multy-Objective transportation Problem by Spanning Tree-Based Genetic Algorithm. IEICE Trans. Fundamentals. Vol.E82-A, No 12.
- [8] Gerard Reinelt. 1994. The Traveling Salesman: Computational Solutions for TSP Applications. Springer-Verlag.
- [9] Hamzah, A, 2001, *Pengenalan Poladengan Fuzzy Clustering*, ACADEMIA ISTA, Vol.4.No.1., Lembaga Penelitian, Institut Sains dan Teknologi AKPRIND, Yogyakarta.
- [10] Michalewicz, Z. 1994. Genetic Algorithms + Data Structures = Evolution Programs. Springer-Verlag, 2nd edition, 1994.
- [11] Traveling Salesman Problem Using Genetic Algorithms, <http://www.lalena.com/ai/tsp/> T.K. Ho and T.H. Yeung, 2000. Railway Junction Conflict Resolution, *Electronics Letters*, Vol. 36, no. 8, pp. 771-772,
- [12] Widayastuti, N and Hamzah, A. 2007. Application of genetic Algorithm to Enhance the Performance of Clustering Fuzzy in Pattern Recognition. *Berkala MIPA*, 17(2), Mei 2007